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CHEMICAL ANALYSES OF LOGAN BLACKBERRY (LOGANBERRY) JUICES.

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THE LOGAN BLACKBERRY (LOGANBERRY).

The Logan blackberry, which is generally known as the Loganberry, originated in 1881, on the grounds of Judge J. H. Logan, of Santa Clara, Cal., who grew it from the seed of the Aughinbaugh blackberry. The seedling was supposed to be the result of hybridization between the blackberry and a red raspberry, presumably the Red Atwerp, which grew beside the blackberry parent [2, 3, 4]. Recent investigations, however, throw doubt on this view and indicate that it is a variety of the trailing blackberry common to the Pacific coast.[5] The plant is an exceedingly robust grower, showing unique foliage and cane growth, as well as fruit. The fruit, shaped like the common blackberry, is sometimes as long as $1\frac{1}{4}$ inches and of a dark color, similar to that of a dark red raspberry.[2] The berry has a characteristic flavor, resembling that of raspberries, both red and black, but more acid than either. A closely-related berry, introduced by Burbank,[2] is the "Phenomenal," which is very similar to the Logan blackberry,

[1] Credit is due R. W. Clough, of the Bureau of Chemistry, for the analytical work on the Washington Logan blackberry juices reported in this bulletin.

[2] Wickson, E. J. The California Fruits and How to Grow Them (1914), p. 417.

[3] Shinn, C. H. Garden and Forest (1894), 7: 465-6.

[4] Gardner, V. R. Biennial Crop Pest and Horticultural Report, 1911-12, pp. 59-65. Oreg. Agr. Exp. Sta.

[5] Is the Hybrid Origin of the Loganberry a Myth? Journal of Heredity (1916), 7: 504-7.

although considered less desirable in some respects. Another trailing berry, well known on the California markets, is the Mammoth blackberry, often called a "black Loganberry." Its color is black, however, whereas the color of the Logan blackberry is red, approaching purple when very ripe. Information on the culture of the Logan blackberry and related species is given in Farmers' Bulletin 998 of this department.

As the ripe Logan blackberry is very tender and does not ship well, it usually is picked when more or less immature, thus insuring a better condition for it when shipped for retail consumption. Somewhat riper fruit may be sent to the canning factories, which, as a rule, are nearer the sources of supply.

USES OF THE LOGAN BLACKBERRY.

Because of its pleasant flavor, Logan blackberry juice is very popular as a beverage, and the berry is also used in making jams, jellies, and soda-fountain sirups. Methods of extracting and treating the juice are constantly being perfected, and this industry, already large, is growing rapidly.

Logan blackberry juice is naturally so sour that it is necessary both to dilute and to sweeten it to obtain a potable article. The addition of sugar in sufficient quantities to mask the acidity makes a product too sirupy to drink, unless the juice is at the same time diluted. The flavor and color of Logan blackberry juice permit a dilution with from 2 to 3 parts of water, and the addition of 1 part of sugar. As a rule, the sirups prepared for soda-fountain use are made by adding sugar to undiluted juices, the composition running from about 1 part of juice and 1 part of sugar to, roughly, 3 parts of juice and 1 part of sugar.

MANUFACTURE OF LOGAN BLACKBERRY JUICE.

The manufacturing processes are practically the same in all the factories inspected.

The berries are collected from the fields near the factories, and crushed as soon thereafter as possible, to prevent any molding. The crushers consist essentially of wooden rollers which run at different speeds, thus giving a tearing motion. From the crushers the pulp is delivered directly to the press cloths, in which it is folded and piled in the presses, which are of the hydraulic type. In many factories only one pressing is made, the refuse pulp being destroyed. Two systems of making a second pressing, however, are employed. In one sufficient cold water to make a workable mixture is added, and, after standing for 24 hours, this pulp-water mixture is pressed again. By the other method, the pomace is steamed in an open tank from 5 to 10 hours, which cooks it sufficiently to make a soft

mass. This material is then pressed like fresh pulp. The second-pressing juices thus obtained have a high color, and are used with first-pressing juice for further blending. Often the juice from the presses is passed through a continuous sterilizer and placed in cans for storage.

Because of variations in the flavor and character of the juice at different periods of the season, all juices are blended before being bottled. This is done by racking off the cans, filtering the juice through a mechanical filter, and then sending it to the blending and mixing tanks, whence it goes to the bottling machine. After bottling the juice is pasteurized by heating it to from 165° to 180° F., for periods varying with the size of the bottles. It is then labeled for the market.

Some of the sweetened but undiluted juices have been described as "concentrated" on the commercial labels. This description is entirely unwarranted, as there is no evidence that any of them have been concentrated or evaporated, and they should properly be described as Logan blackberry sirup.

PURPOSE OF THE INVESTIGATION.

The object of the investigation herein reported was to establish methods for the detection of dilution common in commercial products made from the Logan blackberry, and to set analytical standards for such products. Before the inauguration of this work the only analyses of Logan blackberry juice appear to be those by Lewis and Brown,[1] giving merely specific gravity, acidity, and total sugar. Since then, two articles by Daughters,[2] giving analyses of the berries, the exhausted marc, and several samples of the juice, have appeared.

PREPARATION OF THE ANALYTICAL SAMPLES.

In the work conducted during the season of 1916 berries grown in Washington and Oregon were examined; during 1917 the California berries were analyzed. In 1916 the juice of fresh berries from various places, bought on the open market in Seattle, was expressed in the Seattle laboratory of the Bureau of Chemistry, filtered through cotton plugs, and immediately analyzed. These samples are represented by the numbers 76 to 87, inclusive.

The samples analyzed in the San Francisco laboratory in 1916 were of two classes—the pure expressed juices and the commercial products. The samples represented by numbers 101, 102, 112, and 114 were pressed in the presence of a Government inspector, and are, therefore, known to be pure juices; Nos. 107, 108, 111, 116, 119, and 120, although not pressed in the presence of an inspector, are believed to be

[1] Lewis, C. I., and Brown, F. R., Oregon Agr. Expt. Sta. Bul. 117.
[2] Daughters, M. R., J. Ind. Eng. Chem. (1917), *9*:1043; (1918) *10*:30.

pure juices. The samples analyzed in the San Francisco laboratory in 1917 were prepared as follows:

The Logan blackberries, bought in various California wholesale markets, were pressed as soon as they were received at the laboratory, the expressed juice filtered through cotton plugs, and pasteurized in glass bottles by being heated to about 80° C. and held at that temperature for an hour. The juices kept very well and at the time of analysis showed no signs of fermentation.

METHODS OF ANALYSIS.

SOLIDS.

Ten cubic centimeters of juice or diluted sample was evaporated with about 10 grams of sand, on a water bath, to apparent dryness, and then dried in vacuum for from 10 to 14 hours at 70° C., at about 70 millimeters pressure. This gave approximately 1 gram of dried material to be weighed. For comparison, the total solids by the indirect method, calculated from the specific gravity of the juices, using the wine extract tables,[1] are given. In the case of the samples analyzed in the Seattle laboratory, the solids were determined by the indirect method, from the specific gravity, using the tables for the extract in wine.[1] The solids also were determined by direct drying at the temperature of boiling water, but the figures thus obtained varied so much from the figures obtained by the other methods that they are not included in the tables.

NONSUGAR SOLIDS.

The nonsugar solids were calculated as the difference between the total solids in vacuum and the total sugars. The nonsugar solids of the samples analyzed in Seattle were obtained by subtracting the total sugars from the total solids determined by the indirect method.

SUGARS.

The sugars were determined on suitable dilutions of the sample before and after inversion, by copper reduction methods, using Munson and Walker's tables.[2]

ASH.

Twenty-five cubic centimeters of juice, or 25 grams of sweetened product, was ashed directly in platinum. In 1916, the ash was separated into water-soluble and water-insoluble ash, and the respective amounts of each and their alkalinites determined. As this seemed to supply little information, no such separation was made in 1917.

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[1] U. S. Dept. Agr., Bur. Chem. Bul. 107, rev., 218. [2] Idem, 234.

TOTAL P_2O_5 IN ASH.

This determination was made by the optional volumetric method.[1]

TOTAL ACIDITY.

Ten cubic centimeters of juice was diluted with 50 cubic centimeters of boiled distilled water, and titrated with N/10 alkali, using neutral litmus paper outside the flask as an indicator. The mixture of dry phenolphthalein and sodium sulphate [2] was not satisfactory as an outside indicator, because of the deep color of the samples.

The total acidity of the samples analyzed in Seattle was determined by using azolitmin as an indicator, and the volatile acidity was taken as the difference between the total and fixed acidity.

ADDED SUGAR.

Because of the presence of large amounts of added sugar in the commercial beverages and sirups, weight dilutions of these materials were made, and the analyses carried out on the dilute solutions. For sirups, the most convenient dilutions were from 50 to 100 grams, made up to 500 cubic centimeters.

ORGANIC ACIDS.

The organic acids in a number of samples were determined by the following method: After a preliminary precipitation of the pectins, etc., by alcohol, in a 25-cubic-centimeter portion of the juice, the filtered solution was neutralized with a strong barium hydroxid solution, and an excess of barium acetate added. Coagulation of the barium salts was effected by heating the material on a water bath for from 1 to 2 hours. The barium salts were filtered off, and washed with 95 per cent alcohol.

For the determination of *citric acid*, the barium salts were decomposed with a slight excess of 1:4 sulphuric acid, and the Künz method [3] applied. The values for citric acid thus obtained are practically the same as those for the total acidity by titration, calculated to citric acid.

For *malic* and *tartaric acids* separate portions of the barium salts, prepared as described, were decomposed by heating the material with an excess of sodium sulphate. A test for malic acid was made by the polariscope method.[3] No evidence of the presence of this acid was found.

For *tartaric acid* the barium salts, prepared as already described, were decomposed with sodium sulphate, the solution concentrated to

[1] U. S. Dept. Agr., Bur. Chem. Bul. 107, rev., 4. [2] Jour. A. O. A. C. (1915) *1*, 3:485.
[3] Jour. A. O. A. C. (1916) *2*, 2:182.

50 cubic centimeters, and the method for total tartaric acid in wines [1] applied. No tartaric acid was detected.

Formic acid was tested for in several samples by Fincke's method.[2] Three samples tested gave from 3 to 4 milligrams of formic acid per 100 cubic centimeters.

Benzoic and *salicylic acids*, for which tests were made in the ether extract of the juices, were found to be absent.

RESULTS OF ANALYSES.

Table 1 gives the analyses of the pure Logan blackberry juices in terms of percentage by weight, and Table 2 gives them as grams per 100 cubic centimeters. The juices are classified into those of the season of 1916, which were obtained from Oregon and Washington, and those of the season of 1917, obtained from California only. The Washington and California juices were expressed from the fresh fruit in the laboratory, while the Oregon juices were obtained directly from the factories. Table 3 shows the results of the analyses of commercial beverages and sirup as they appear on the market, and Table 4 shows the approximate composition of these products as determined from Table 3. For convenience of comparison the analyses of the commercial beverages and sirup, as well as of the expressed juices, are given in terms of percentage. Because of the addition of sugar to the commercial products, a comparison on the basis of grams per 100 cubic centimeters would be difficult. The data on the pure juices most valuable for the interpretation of analyses have, therefore, been restated in terms of percentage by weight.

[1] U. S. Dept. Agr., Bur. Chem. Bul. 107, rev., 86.

[2] Jour. A. O. A. C. (1916) 2, 1: 94.

TABLE 1.—*Analyses of pure Logan blackberry juices.*

SEASON OF 1916.

Sample No.	Source.	Specific gravity, 15.6°/15.6° C.	Solids.		Nonsugar solids.		Reducing sugar, before inversion.	Sucrose by copper.	Total ash.	Alkalinity of ash.	Total acid as citric.	P_2O_5, total.
			Indirect.[1]	In vacuo.	Direct.	Indirect.						
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Cc N/10 acid per 100 grams.*	*Per cent.*	*Mgm. per 100 grams.*
	Washington:											
76	White River	1.046	11.42	.....	.....	5.74	5.68	.....	0.375	57.0	2.28	28.2
77	Kent	1.042	10.45	.....	.....	5.41	5.04	.....	.367	54.5	2.11	25.1
78	Keyport	1.042	10.45	.....	.....	5.37	5.08	.....	.330	49.5	2.25	23.8
79	Kingston	1.045	11.18	.....	.....	5.99	5.19	.....	.360	55.9	2.33	20.4
80	Thomas	1.0495	12.24	.....	.....	5.41	6.76	0.07	.328	48.4	2.12	23.0
81	Kennydale	1.0485	12.00	.....	.....	4.86	7.14	.....	.357	48.5	1.71	18.5
82	Poulsbo	1.040	9.98	.....	.....	4.89	5.04	.05	.341	48.8	2.10	22.6
83	Kingston	1.0445	11.05	.....	.....	5.05	6.00	.....	.357	49.4	1.91	17.5
84	Kennydale	1.0455	11.30	.....	.....	5.23	5.96	.11	.386	55.9	2.19	14.2
85	White River	1.0440	10.92	.....	.....	4.82	5.98	.12	.324	49.4	1.94	13.4
86	South Park	1.0460	11.42	.....	.....	4.79	6.52	.11	.245	39.8	1.92	15.7
87	Kent	1.0355	8.90	.....	.....	4.36	4.34	.20	.327	45.6	1.60	20.3
	Oregon:											
101	Salem	1.0427	10.62	9.53	2.80	3.89	6.71	.02	.341	51.8	1.76	18.0
102	Do	1.0449	11.15	9.91	3.34	4.58	6.54	.03	.428	63.2	1.92	25.2
112	Do	1.0490	12.12	10.97	3.31	4.46	7.59	.07	.434	58.7	1.79	22.9
114	Sheridan	1.0467	11.58	10.67	2.98	3.89	7.58	.11	.434	56.0	1.42	23.9
111	Eugene	1.0410	10.22	9.24	3.60	4.58	5.30	.34	.378	58.4	2.12	28.4
116	Newberg	1.0478	11.84	10.90	3.20	4.14	7.64	.06	.393	59.6	1.67	33.1
119	Cornelius	1.0470	11.65	10.99	3.26	3.92	7.68	.05	.391	55.2	1.84	28.9
108	Albany	1.0381	9.52	8.79	3.45	4.18	5.26	.08	.397	60.9	1.72	32.2
120	Cornelius (early pressing)	1.0444	11.02	10.21	3.92	4.73	6.29	.00	.428	60.3	2.27	32.1
107	Salem (5 months in tin)	1.0380	9.50	9.27	3.88	4.11	5.34	.05	.339	55.5	2.00	20.4
	Maximum	1.0495	12.24	10.99	3.92	5.99	7.68	.34	.434	63.2	2.33	33.1
	Minimum	1.0355	8.90	9.24	2.80	3.89	4.34	.02	.245	45.6	1.42	13.4
	Average	1.0454	10.93	10.05	3.37	4.75	6.12	.10	.366	54.7	1.96	22.6
103	Second pressing of No. 102	1.0235	5.95	5.26	2.36	3.05	2.86	.04	.320	42.5	1.29	28.3
117	Second pressing of No. 116	1.0238	6.02	5.69	2.40	2.40	3.25	.04	.264	36.9	.88	26.2

[1]From Table VI, U. S. Dept. Agr., Bur. Chem. Bul. 107, rev., 221.

TABLE 1.—*Analyses of pure Logan blackberry juices*—Continued.

SEASON OF 1917.

Sample No.	Source.	Specific gravity, 15.6°/15.6° C.	Solids.		Nonsugar solids.		Reducing sugar, before inversion.	Sucrose by copper.	Total ash.	Alkalinity of ash.	Total acid as citric.	P_2O_5, total.
			Indirect.	In vacuo.	Direct.	Indirect.						
	California:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Cc N/10 acid per 100 grams.*	*Per cent.*	*Mgm. per 100 grams.*
1734	Sebastopol	1.0488	12.08	11.12	3.73	4.69	7.39	.00	.459	64.2	1.82	26.7
3889	Watsonville	1.0454	11.28	10.22	3.06	4.08	7.11	.09	.446	60.8	1.58	30.6
3892	San Carlos	1.0412	10.28	9.18	3.13	4.23	6.00	.05	.626	61.2	1.50	34.1
3893	San Jose	1.0438	10.88	9.77	3.65	4.75	6.08	.05	.560	72.9	1.93	35.2
3895	Lawrence	1.0484	11.98	10.61	3.43	4.80	7.09	.09	.434	71.3	1.85	36.0
3896	Sebastopol	1.0431	11.72	9.81	3.74	5.65	6.05	.02	.460	68.8	1.96	20.6
3898	Watsonville	1.0407	10.16	9.21	3.53	4.48	5.61	.07	.467	61.5	1.88	33.1
4656	Gardena	1.0384	9.60	8.72	3.54	4.43	5.11	.06	.480	62.4	1.96	31.5
4657	Puento	1.0396	9.88	9.07	3.39	4.12	5.68	.10	.507	70.4	1.06	40.3
	Maximum	1.0488	12.08	11.12	3.74	5.65	7.39	.10	.626	72.9	1.96	40.3
	Minimum	1.0384	9.60	8.72	3.06	4.08	5.11	.02	.434	60.8	1.06	20.6
	Average	1.0433	10.87	9.75	3.47	4.58	6.23	.06	.493	65.9	1.73	32.0

TABLE 2.—*Analyses of pure Logan blackberry juices.*

SEASON OF 1916.

Sample No.	Source.	Specific gravity, 15.6°/15.6° C.	Solids.		Nonsugar solids.		Reducing sugar before inversion.	Sucrose by copper.	Total ash.	Alkalinity of ash.	Alkalinity number of ash.[2]	Total acid as citric.	P_2O_5 in ash.	Citric acid.[3]
			Indirect.[1]	In vacuo.	Direct.	Indirect.								
			Grams per 100 cc.	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*	*Cc N/10 acid per 100 grams*	*Cc N acid per gram.*	*Grams per 100 cc.*	*Mgm. per 100 cc.*	*Grams per 100 cc.*
	Washington:													
76	White River	1.046	11.91	.....	.....	5.97	5.94	.....	0.392	59.6	15.2	2.38	29.5	.....
77	Kent	1.042	10.87	.....	.....	5.62	5.25	.....	.382	56.8	14.9	2.20	26.2	.....
78	Keyport	1.042	10.87	.....	.....	5.58	5.29	.....	.344	51.6	15.0	2.35	24.8	.....
79	Kingston	1.045	10.65	.....	.....	6.25	5.40	.....	.376	58.4	15.5	2.43	21.3	.....
80	Thomas	1.0495	12.82	.....	.....	5.66	7.09	0.07	.344	50.8	14.8	2.23	24.1	.....
81	Kennydale	1.0485	12.56	.....	.....	5.07	7.49	.....	.374	50.8	13.6	1.79	19.4	.....
82	Poulsbo	1.040	10.35	.....	.....	5.06	5.24	.05	.355	50.8	14.3	2.18	23.5	.....
83	Kingston	1.0445	11.52	.....	.....	5.25	6.27	.....	.373	51.6	13.8	2.00	18.3	.....
84	Kennydale	1.0455	11.78	.....	.....	5.43	6.23	.12	.404	58.4	14.4	2.29	14.9	.....
85	White River	1.0440	11.39	.....	.....	5.03	6.24	.12	.338	51.6	15.3	2.03	14.0	.....
86	South Park	1.0460	11.91	.....	.....	4.98	6.82	.11	.256	41.6	16.3	2.01	16.4	.....
87	Kent	1.0355	9.18	.....	.....	4.49	4.49	.20	.339	47.2	13.9	1.66	21.0	.....
	Oregon:													
101	Salem	1.0427	11.27	9.94	2.92	4.25	7.00	.02	.355	54.0	15.2	1.84	18.8	1.72
102	Do	1.0449	11.62	10.36	3.50	4.76	6.83	.03	.447	66.0	14.7	2.01	26.3	2.08
112	Do	1.0490	12.69	11.51	3.47	4.66	7.96	.07	.455	61.6	13.5	1.88	24.0	.....
114	Sheridan	1.0467	12.09	11.17	3.13	4.05	7.93	.11	.454	59.4	13.0	1.49	25.0	.....
111	Eugene	1.0410	10.61	9.62	3.75	4.74	5.52	.35	.393	60.8	15.5	2.21	29.6	.....
116	Newberg	1.0478	12.38	11.42	3.36	4.32	8.00	.06	.412	62.4	15.1	1.75	34.7	1.81
119	Cornelius	1.0470	12.17	11.51	3.42	4.08	8.04	.05	.409	57.8	14.2	1.93	30.3	.....
108	Albany	1.0381	9.86	9.13	3.59	4.32	5.46	.08	.412	63.2	15.3	1.79	33.4	.....
120	Cornelius (early pressing)	1.0444	11.49	10.66	4.09	4.92	6.57	.00	.447	63.0	14.1	2.37	33.5	.....
[4] 107	Salem (5 months in tin)	1.0404	10.45	9.62	4.03	4.86	5.54	.05	.352	57.6	16.3	2.08	21.2	.....
	Maximum	1.0495	12.82	11.51	4.09	6.25	8.04	.35	.455	66.0	16.3	2.43	34.7	.....
	Minimum	1.0355	9.18	9.13	2.92	4.08	4.49	.00	.256	41.6	13.0	1.66	14.0	.....
	Average	1.0440	11.36	10.49	3.53	4.97	6.39	.08	.382	56.1	14.4	2.04	24.1	.....
[5] 103	Second pressing of No. 102	1.0235	6.07	5.38	2.40	3.10	2.93	.04	.328	43.5	13.2	1.32	29.0	1.13
117	Second pressing of No. 116	1.0238	6.15	5.83	2.46	2.78	3.33	.04	.270	37.8	13.9	.90	26.8	.81

[1] From Table V, U. S. Dept. Agr., Bur. Chem. Bul. 107, rev., 218.
[2] Buttenberg, Zts. Nahr. Genussm. (1905) *9*: 142.
[3] Künz method.
[4] This sample was held in tin 5 months (4.1 milligrams tin per 100 cc).
[5] This sample contained 0.264 gram malic acid per 100 cc. Apparently other fruit had been added.

TABLE 2.—*Analyses of pure Logan blackberry juices*—Continued.

SEASON OF 1917.

Sample No.	Source.	Specific gravity, 15.6°/15.6° C.	Solids.		Nonsugar solids.		Reducing sugar before inversion.	Sucrose by copper.	Total ash.	Alkalinity of ash.	Alkalinity number of ash.	Total acid as citric.	P_2O_5 in ash.	Citric acid.
			Indirect.	In vacuo.	Direct.	Indirect.								
			Grams per 100 cc.	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*	*Cc N/10 acid per 100 grams*	*Cc N acid per gram.*	*Grams per 100 cc.*	*Mgm. per 100 cc.*	*Grams per 100 cc.*
	California.													
1734	Sebastopol	1.0488	12.64	11.66	3.91	4.89	7.75	.00	.481	67.3	14.0	1.91	28.0	.....
3889	Watsonville	1.0454	11.75	10.72	3.20	4.24	7.43	.09	.466	63.5	13.6	1.65	32.0	.....
3892	San Carlos	1.0412	10.66	9.56	3.26	4.36	6.25	.05	.652	63.7	9.8	1.56	35.5	.....
3893	San Jose	1.0438	11.34	10.20	3.81	4.95	6.34	.05	.584	76.1	13.0	2.01	36.7	.....
3895	Lawrence	1.0484	12.53	11.12	3.60	5.01	7.43	.09	.455	74.7	16.4	1.94	37.7	.....
3896	Sebastopol	1.0431	11.15	10.23	3.90	4.82	6.31	.02	.480	71.8	14.9	2.04	21.5	.....
3898	Watsonville	1.0407	10.53	9.58	3.67	4.62	5.84	.07	.486	64.0	13.2	1.96	34.5	.....
4656	Gardena	1.0384	9.93	9.05	3.68	4.56	5.31	.06	.498	64.8	13.0	2.03	32.7	.....
4657	Puento	1.0396	10.25	9.43	3.42	4.27	5.90	.11	.527	73.2	13.9	1.50	41.9	.....
	Maximum	1.0488	12.64	11.66	3.91	5.01	7.75	.09	.652	76.1	16.4	2.04	41.9	.....
	Minimum	1.0384	9.93	9.05	3.20	4.24	5.31	.00	.455	63.5	9.8	1.50	28.0	.....
	Average	1.0433	11.19	10.17	3.61	4.63	6.51	.06	.514	68.8	13.5	1.84	33.4	.....

TABLE 3.—*Analyses of commercial Loganberry juices and sirups.*

SEASON OF 1916.

Sample No.	Description from labels.	Specific gravity, 15.6°/15.6° C.	Solids.		Non-sugar solids.	Reducing sugar before inversion.	Sucrose, by copper.	Total ash.	Total alkalinity.	Alkalinity number of ash.	Total acid as citric.	Volatile acid as acetic.	P_2O_5, total.
			Indirect.[1]	In vacuo.									
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Cc N acid per gram.*	*Per cent.*	*Per cent.*	*Mgm. per 100 grams.*
104	Loganberry juice with sugar	1.1551	35.20	35.40	3.54	12.28	19.58	0.293	31.0	10.5	1.17	0.02	18.2
105	Loganberry sirup	1.2174	47.20	47.77	1.69	14.46	30.62	.207	30.5	14.7	1.06	.01	13.5
106	Loganberry juice with sugar and water	1.0513	12.68	12.59	.43	5.99	6.17	.103	13.9	13.5	.44	.01	5.9
109	Loganberry juice with sugar	1.2549	53.96	54.07	2.79	33.25	18.03	.194	24.2	12.4	1.31	.03	19.1
110	Loganberry juice, cane sugar and water added	1.0809	19.48	19.27	1.72	8.74	8.82	.151	22.4	14.8	.92	.02	12.6
115	Logan juice, ready to drink	1.0673	16.38	16.14	2.06	5.38	8.70	.176	26.1	14.8	.66	.02	13.1
118	Logan juice, concentrated	1.1297	30.02	30.01	2.89	11.85	15.27	.281	40.0	14.2	1.12	.02	21.9
122	Loganberry juice, sugar added	1,1518	34.54	34.11	2.98	24.60	6.53	.313	44.4	14.2	1.49	.02	24.1
123	Loganberry juice, sirup added	1.0664	16.18	15.95	1.75	9.65	4.54	.171	25.0	14.6	.85	.02	10.2
124	Loganberry juice beverage	1.0709	17.20	16.99	1.71	8.73	6.55	.149	25.0	16.8	.82	.06	11.0
125	Loganberry juice, sugar added	1.1801	40.14	39.74	4.25	35.49	None.	.321	47.0	14.6	1.53	.09	22.0
121	40–60 Loganberry beverage	1.0673	16.38	16.40	1.75	7.71	7.04	.144	20.9	14.5	.68	.02	9.5
1376	Loganberry juice	1.0817	19.65	19.27	2.64	11.29	5.34	.226	33.0	14.6	.93	.04	22.4
1377	Loganberry juice sirup	1.2625	55.30	55.75	4.06	38.94	12.75	.218	33.4	15.3	1.09	.03	17.8
20335–L	Loganberry juice with sugar	1.1486	33.90	33.10	2.83	24.47	5.80	.270	40.8	15.1	1.33	.02	16.2
20337–L	.....do	1.1526	34.70	33.94	3.08	26.81	4.05	.325	48.4	14.9	1.50	.03	22.4
20329–L	Loganberry juice, diluted and sugared	1.0696	16.92	16.80	2.03	12.60	2.17	.201	29.4	14.6	.81	.02	15.0

[1] From Table VI, U. S. Dept. Agr., Bur. Chem. Bul. 107, rev., 221.

TABLE 4.—*Approximate composition of commercial Loganberry products.*

Sample No.	Description from label.	Composition.		
		Parts juice.	Parts sugar.	Parts water.
104	Loganberry juice with sugar	3	1	0
105	Loganberry sirup	3	2	0
106	Loganberry juice, with sugar and water	2	1	5
109	Loganberry juice with sugar	1	1	0
110	Loganberry juice with cane sugar and water added	3	1	2
115	Logan juice, a beverage ready to drink	5	1	4
118	Logan juice concentrated	3	1	0
121	40–60 Loganberry beverage	4	1	5
122	Pure Loganberry juice, sugar added	3	1	0
123	Loganberry juice, sirup added	5	1	4
124	Loganberry juice beverage	5	1	4
125	Loganberry juice, sugar added	2	1	0
1376	Loganberry juice	3	1	2
1377	Concentrated Loganberry juice sirup	1	1	0
20335–L	Loganberry juice with sugar	3	1	0
20337–L	Loganberry juice with sugar	3	1	0
20339–L	Loganberry juice, diluted and sugared beverage	5	1	4

DISCUSSION OF RESULTS OF ANALYSES.

The juices from berries grown in Washington and Oregon differ markedly in composition from those from fruit produced in California. There is also a very large variation in the composition of juices from fruit grown in the various parts of these States. This probably is due to the fact that in the northern section the berries are grown under heavy rainfall, whereas the land in California usually is irrigated. Apparently California juices have a somewhat higher ash content and a lower acid content than the juices from the more northern States. Observations extending over several seasons would, of course, be necessary to confirm this apparent difference.

It would seem impossible to determine exactly the amount of added water present in Logan blackberry juice. Its presence can be detected, however, and the amount roughly approximated. Table 5 gives the tentative limits suggested for the most significant determinations of Logan blackberry products. The nonsugar solids are calculated from the solids in vacuum.

TABLE 5.—*Tentative limits for Logan blackberry juices.*

Source.	Nonsugar solids.		Ash.		Acids, as citric.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Washington and Oregon	3.92	2.80	0.43	0.25	2.33	1.42
California	3.74	3.06	.63	.43	1.96	1.06

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